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ABSTRACT

The conceptual basis for using individual expectancy scores as a means for determining the success of instruction is presented. An expected gain score is computed for each student, based on a pretest score. The assumption is made that without a change in the learning environment the student will continue to gain at his previous average rate. The data are displayed in an achievement idiograph, which shows individual grade placement based on the pretest, expectancy score, and posttest placement. Data can be used at the individual student level by classroom teachers or aggregated by classroom, school, or district to serve the needs of other decision-makers. Less than expected gain can serve to quickly draw attention to areas of weakness in the curriculum; more than expected gain can be considered as "success." Idiographic analysis eliminates the necessity for control groups and historical data as means for assessing program success. (Author/KM)

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EDUCATION
depiction and analysis of educational achievement by idiographs

EVALUATION METHODS
same

STATISTICS
same

TESTING
same

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MSD

EDUCATION

IDIOGRAPHIC ANALYSIS OF ACHIEVEMENT MEASURES

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INTRODUCTION

One of the problems that has plagued the evaluation of compensatory programs has been establishing the significance of obtained achievement gains. Traditional design calls for random assignment of students to experimental and control groups. But compensatory education is designed to meet the specific needs of identified groups of students. Therefore, it is inappropriate to randomly assign students to treatments or non-treatment groups. Even if a control group were available outside the program, the assumption of randomization that lies behind the tests of statistical significance most commonly used is violated. In addition, it is often difficult, if not impossible, to find a group of comparable students who are receiving a "pure", traditional education.

A solution often used is to rely on historical data and to measure the effect of some treatment against the results achieved with like groups of students in previous years who did not receive special programs. Average gains for these groups can be used as an expectancy prediction of future gains by like groups if they receive no special treatment. Standardized tests are normed to show ten months growth for an instructional year. Compensatory programs generally deal with a population gaining from four to seven months in a ten-month instructional year. Therefore, if a treatment raises that gain to an average of ten months, we can attribute the additional gain to the treatment with a reasonable degree of confidence.

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This concept was developed during the course of our evaluation of Project R-3 in San Jose Unified School District as a management tool for the project staff. Project R-3 is a demonstration program funded by the California State Department of Education under Assembly Bill 938.

If the population under consideration is heterogeneous, and there is a wide spread of pre-test scores, historical data for that group are inappropriate. We have been studying over the last two years a total grade population in which a large proportion of students have academic deficiencies, but many of the students score at or above grade-level on pre-tests. The range of their scores on the pre-test at the start of the eighth grade was from the second to the tenth grade in both reading and mathematics.

Our solution is to use *individual* expectancy scores, based on participants' pre-test scores, and to couple them with individual achievement scores. This paper details the conceptual basis for an idiographic analysis of these expectancy and achievement scores and illustrates its application.

DERIVING EXPECTANCY SCORES

We have used a form of expectancy data that is derived from data about each of the students participating in the program. We make the assumption that a student's pre-test given before the special program starts represents the average rate of gain he has made during his previous years of schooling. Since we are dealing with an entering eighth-grade population (the first year of a two-year longitudinal analysis of a continuing program) we divide the entering grade-equivalent score for each student by eight to obtain his average rate of gain over the previous years (K through 7) he has been in school. We then assume that with no special treatment he will continue to make the same *average* gain in future years.

We would be cautious about using this measure in the first two or three grades because there would not be sufficient opportunity for random variations in learning rate to average out. While we do not assume a constant rate of gain over the years for an individual student, we consider the average rate of gain over the past years to be a reasonable predictor of the average gain during future years and in this case for the next two years. We are also assuming that a child had a year of kindergarten since the expected score for a large population entering first grade is 1.0.

If there is a difference between his expected gain and his achieved gain at the end of the program it seems reasonable to attribute that difference to the effect of the program in which he was participating. A t-test on the difference between the expected and observed means can be used to determine whether the difference is significant.

Since the relationship between entering achievement score and expected gain is linear, it is easy to construct a *two-year expected gain* graph using the formula:

$$\text{expected gain} = \frac{\text{entering score}}{8} \times 2$$

The entering score is read off the x axis, and the expected score at the end of two years off the y axis. An alternative, of course, would be to construct a table of expected scores using the same formula. For each student we computed an average gain over the past eight years. Based on this, an expected two-year gain for each student in each subject was derived.

OBSERVED GAINS

There were 113 students for whom we had eighth-grade (October 1970) pre-tests and ninth-grade (June 1972) post-tests in both reading and mathematics. Tables 1 and 2 show the number of students in each range of months gained in reading and mathematics, respectively.

Table 3 summarizes the expected and observed gain for the group as a whole.

A t-test was done on each set of scores, reading and math. For reading, the difference is significant well beyond not only the .001 level, but beyond any tabulated significance level. For math, the difference is significant at the .001 level.

We consider this to be good evidence that both programs made real changes in the rate of achievement gain for the program students.

Table 1

EXPECTED AND OBSERVED TWO-YEAR GAINS IN READING

Months Gained	Number of Students	
	Expected	Observed
<1	0*	6
1-5	3	5
6-10	48	8
11-15	38	9
16-20	15	15
21-25	8	8
26-30	1	12
31-35	0	18
36-40	0	13
41-45	0	9
46-50	0	5
51-55	0	4
56-60	0	1

*It is an artifact of the process for estimating expected gain that no losses can be predicted.

Table 2

EXPECTED AND OBSERVED TWO-YEAR GAINS IN MATH

Months Gained	Number of Students	
	Expected	Observed
<1	0*	4
1-5	1	12
6-10	34	17
11-15	43	22
16-20	26	13
21-25	8	18
26-30	1	9
31-35	0	11
36-40	0	3
41-45	0	3
46-50	0	0
51-55	0	0
56-60	0	1

*It is an artifact of the process for estimating expected gain that no losses can be predicted.

Table 3

SUMMARY EXPECTED AND OBSERVED DATA

	Expected Gain	Observed Gain
Reading	1.23	2.60
Math	1.35	1.74

ACHIEVEMENT IDIOGRAPHS

In order to visually display these data in a way useful as a management tool, we constructed the achievement idiographs for reading and math shown in Figs. 1 and 2. The x axis shows individual students. The y axis shows grade levels. The idiograph shows the pre-test grade level, the expected gain and the post-test grade level.

It is possible at a quick glance to ascertain which individual students are making better than or less than expected gains. If names were attached to each student's record, the measure of success for individual students could be seen. This information could be used for planning individualized programs for each student. If he is progressing well, perhaps no changes are needed. If he is progressing at the expected no-treatment level, or only slightly better than expected, perhaps a change in his instructional program is indicated.

If we look at the achievement idiograph for mathematics we can readily see that the program is not reaching students with the higher entering scores. This suggests that either the materials are not suited to the students or that the style and content of the presentations are not suitable. In contrast, reading did very well for the higher ability students, but did not achieve uniformly good results with students whose entering scores were at about the third grade level.

The teacher or administrator can pose many questions related to the achievement of the group under consideration and quickly have an answer by looking at the idiograph. For example, he might want to know how many students are at any given grade level, or how many students who entered at some specified grade level left the program at the tenth grade level. In addition, by drawing vertical lines in the appropriate places on the idiograph, a class may be divided into

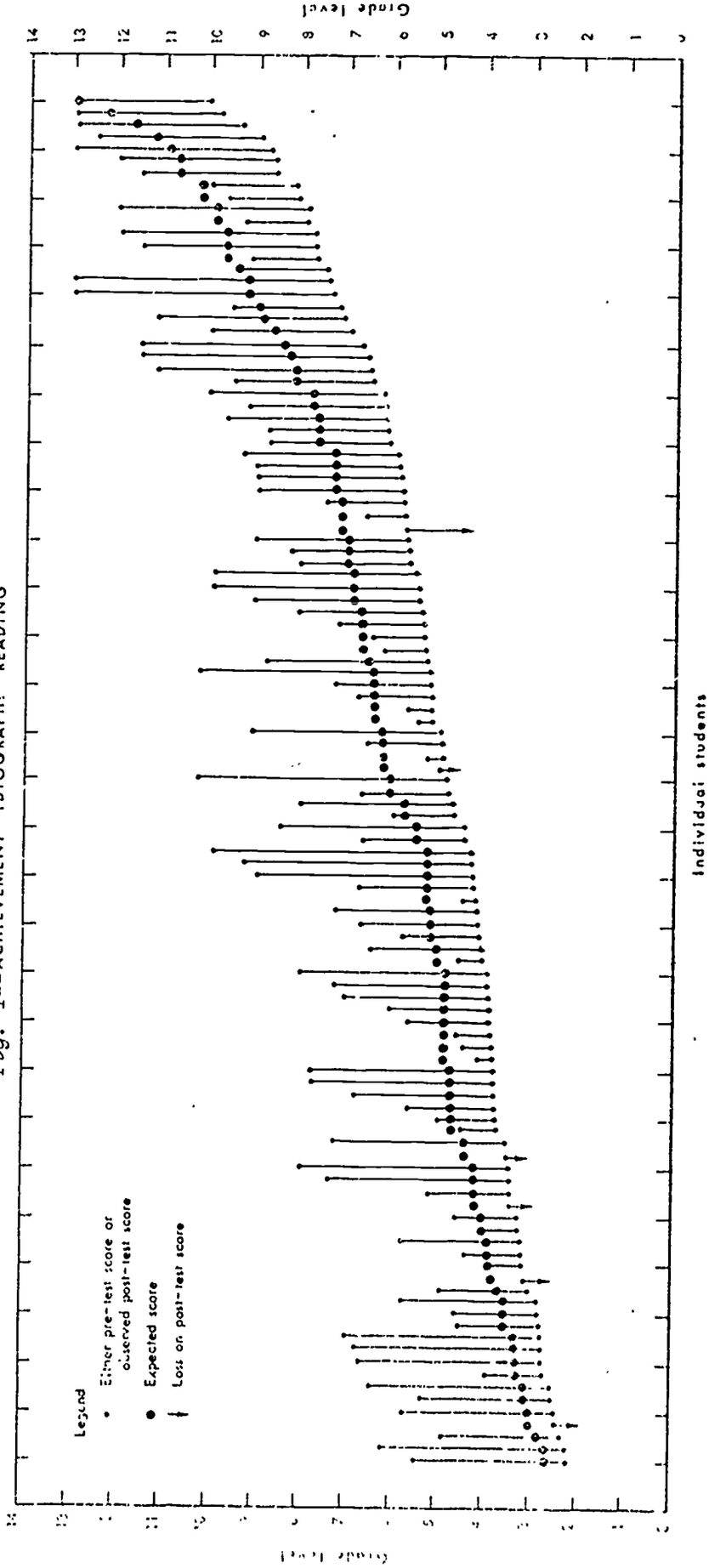

Fig. 1--ACHIEVEMENT IDIOGRAPH: READING

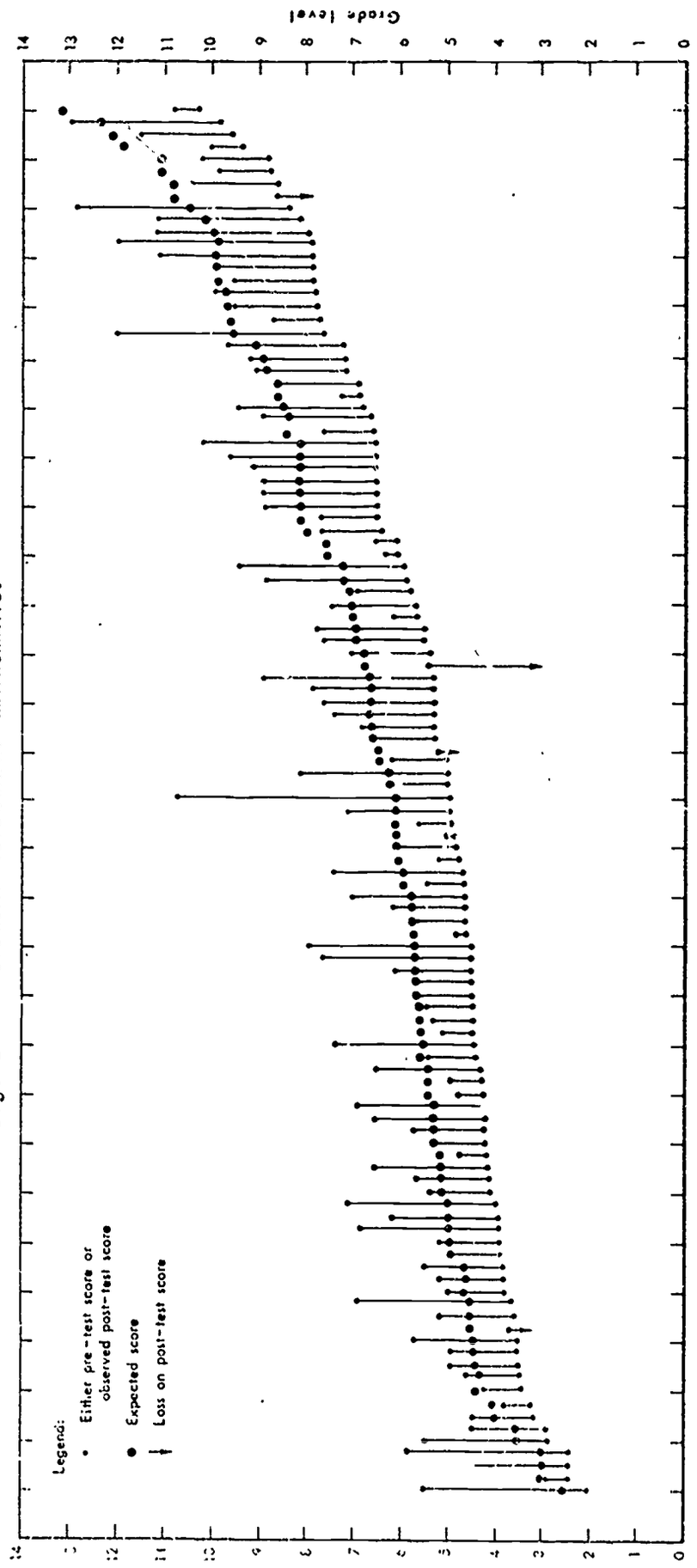

Fig. 2--ACHIEVEMENT IDIOGRAPH: MATHEMATICS

quartiles, and an assessment of the achievement of different ability groups made. These kinds of information are needed as a basis for improving the curriculum for individual students as well as for groups of students with similar needs.

USES OF THE ACHIEVEMENT IDIOGRAPH

Idiographic analysis provides the school staff, administrators and teachers, with a useful tool for increasing the effectiveness of education. We have presented some ways in which the teacher might use it to modify curriculum and adjust a program to the abilities of individual students in his class.

If teachers are to be held accountable for the outcomes of their students, idiographic analysis provides a fair basis for making judgments about their success *in relation to the ability of their students.* A teacher whose students make better than expected gains would objectively be deemed successful; the teacher whose students made less than expected gains would have the information necessary to improve his curriculum. In order for the data to be of maximum use to the teacher, it must be available on a timely basis. This should present no real problem because, given pre- and post-test scores and a table of expected scores, the idiograph is quickly constructed.

While the idiograph is a useful tool at the classroom level, to be useful at other levels in the school district, or at the state level, it needs to be adapted to higher levels of aggregation.

In the idiographic analysis of outcome the conceptual basis is the same for classrooms, schools and districts as that developed in this paper for programs. This is shown in Fig. 3.

As can be seen from Fig. 3 the individual entities in idiographs represent higher levels of aggregation. Plotted on the illustrative idiographs are *average* scores for the appropriate level of aggregation. Such idiographs can be constructed for any subject at any grade level. It should be borne in mind that as the level of aggregation increases from the individual the detail necessary for curriculum

improvement is lost. The purpose of using idiographic analysis at the higher levels is as an indicator of achievement. Effective or ineffective classrooms or schools are readily pinpointed. Where program improvement is indicated, further idiographic analysis can be done at a finer level of detail.

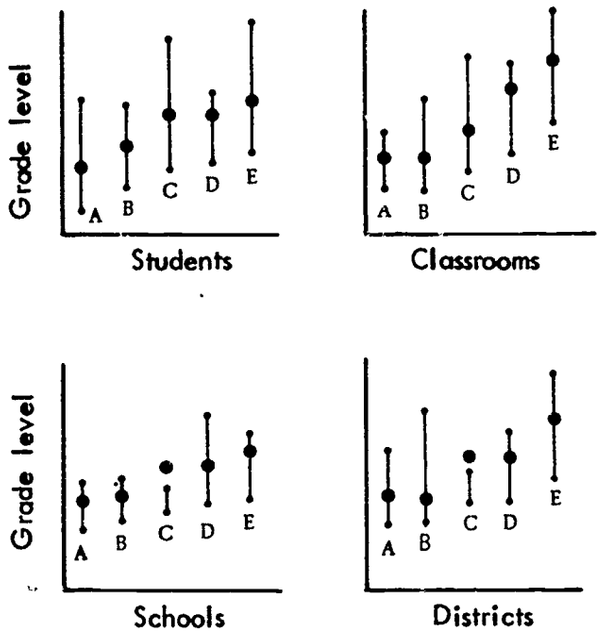

Fig. 3--Illustrative achievement idiographs for different levels of aggregation

If the relationship between socio-economic status and achievement is as strong as demonstrated, the expectancy scores of different schools will be quite different. Their achievement can then be compared in relation to their own population. It removes the necessity for publishing data about the socio-economic characteristics of each school; that information is inherent in the expectancy score.

Finally, idiographic achievement analysis could be used to compare across programs. Title I programs could present their data in this fashion and their success be judged in relation to what can reasonably be expected in terms of improving student achievement. Demonstration programs could also be compared in terms of how well they do in relation to expectancy for their populations.

In this mode of idiographic achievement analysis, each program's achievement parameters, the pre-test score, the expectancy score and the post-test score, would be presented by quartile. This would enable the State Department of Education to be selective in their recommendations about which demonstration programs can be effectively replicated for different student populations.

In short, idiographic achievement analysis provides a basis for evaluating the success of any educational endeavor in realistic terms. It provides a substitute for absolute standards of performance and measures progress in terms of achievement above expectancy, while at the same time it provides a tool to be used for educational improvement.